(12) UK Patent Application (19) GB (11) 2 302 054 (13) A

(43) Date of A Publication 08.01.1997

(21) Application No 9611446.7

(22) Date of Filing 31.05.1996

(30) Priority Data
(31) 9511045 (32) 01.06.1995 (33) GB
9524504 30.11.1995
9600876 17.01.1996

(71) Applicant(s)
Ralph Gladwin Haynes
6 Castle Green, Laughton-En-Le-Morthen,
SHEFFIELD, Yorkshire, S31 7YY, United Kingdom

(72) Inventor(s)
Ralph Gladwin Haynes

(74) Agent and/or Address for Service
Batchellor, Kirk & Co
2 Pear Tree Court, Farringdon Road, LONDON,
EC1R 0DS, United Kingdom

(51) INT CL^6
B21B 1/46 13/22

(52) UK CL (Edition O)
B3F FAA FCF F216 F312 F322
B3A A124
B3M MC

D 3

(56) Documents Cited
GB 1408827 A GB 1298323 A GB 1183646 A
GB 1117952 A US 5146781 A
Patent Abstracts of Japan vol 6 no 216 (M-168), 1982
& JP 57 0121809 A

(58) Field of Search
UK CL (Edition O) B3A , B3F FAA FCF FNK , B3M MC
INT CL^6 B21B 1/46 13/22
Online:WPI, CLAIMS

(54) Production of metal strip

(57) An installation for the production of metal strip from molten metal comprises at least one continuous caster capable of producing bar and a hot strip mill for rolling bar to strip. The path of the bar exiting the caster is not in alignment with the path taken by the bar entering the mill. A rotary turning table 17 downstream of the caster 1 is movable between positions in which it permits a portion of bar from the caster to move onto the table and it permits a portion of bar on the table to move to a position from which it can enter the mill 7 respectively.

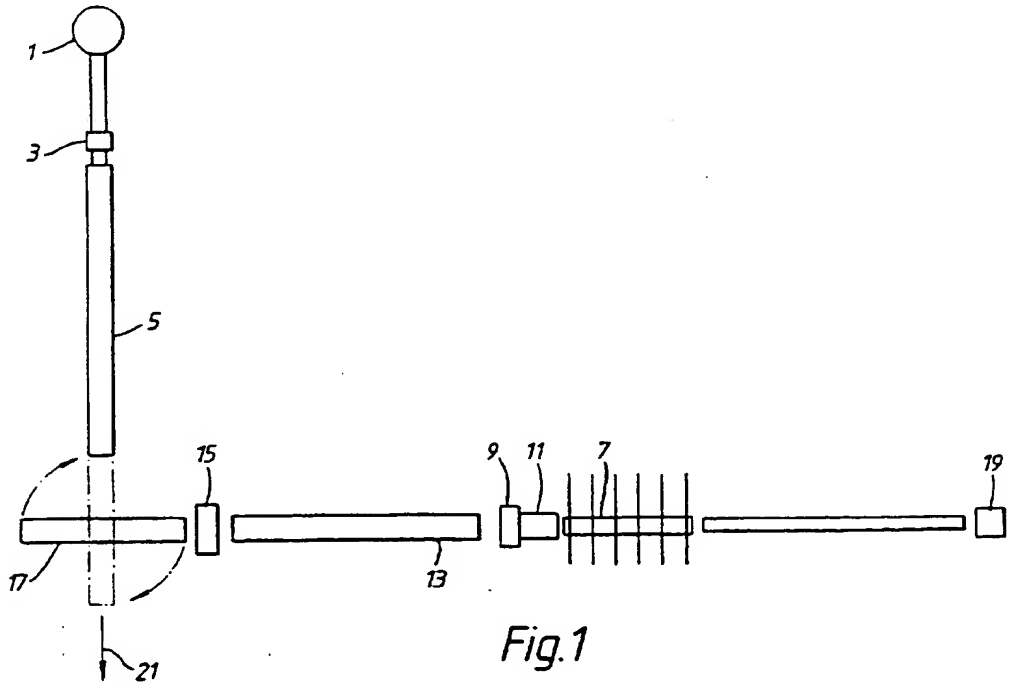

Fig.1

GB 2 302 054 A

BNSDOCID: <GB_____2302054A__I_>

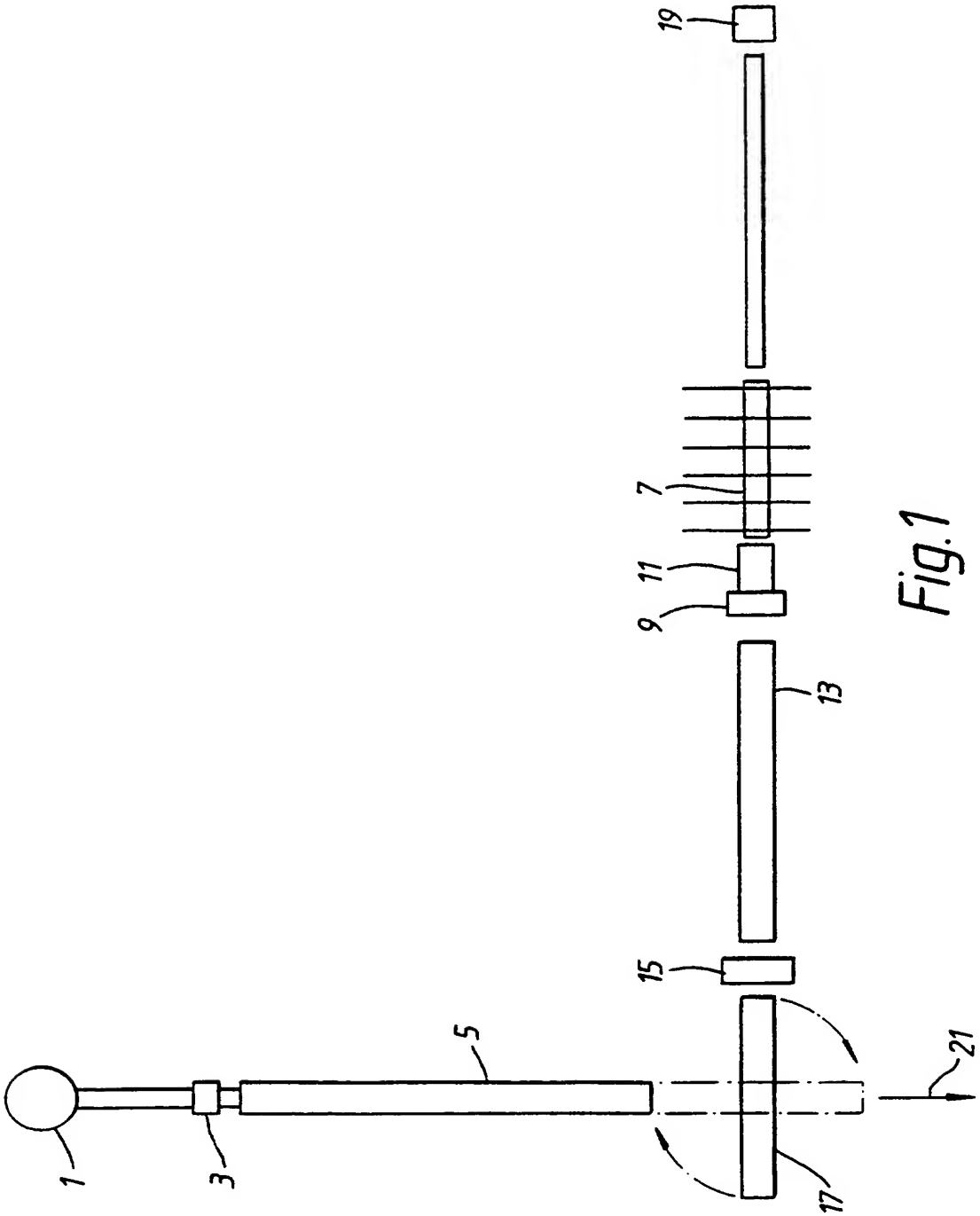

Fig.1

BNSDOCID: <GB ___2302054A__I_>

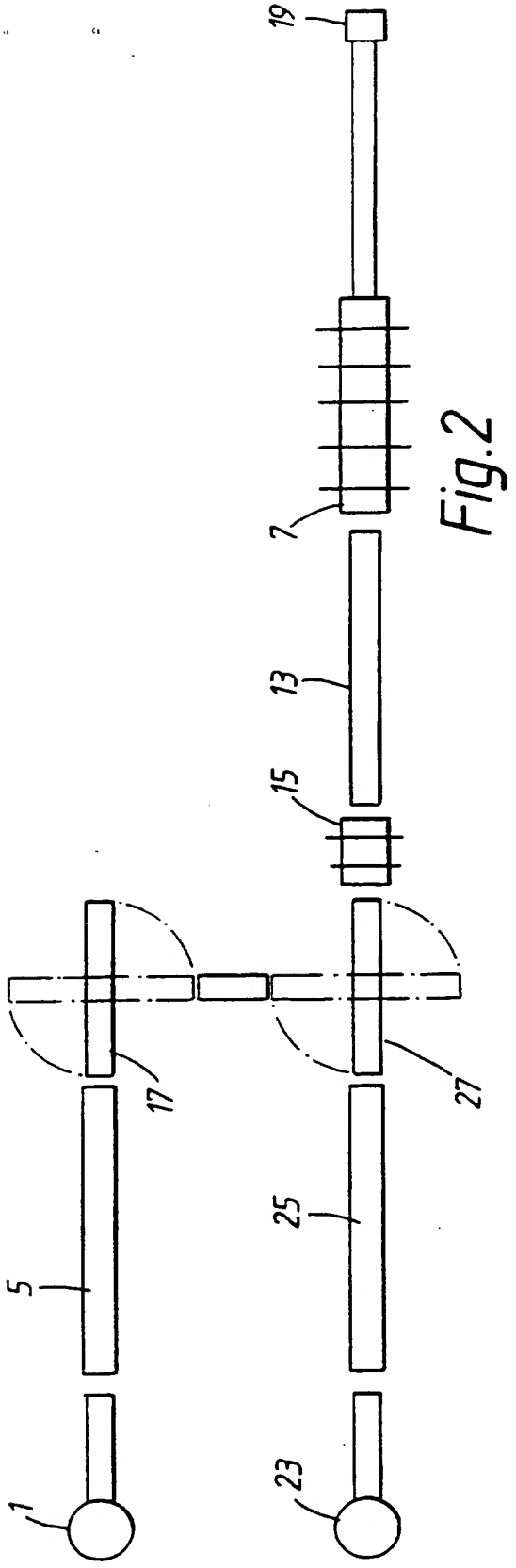

Fig.2

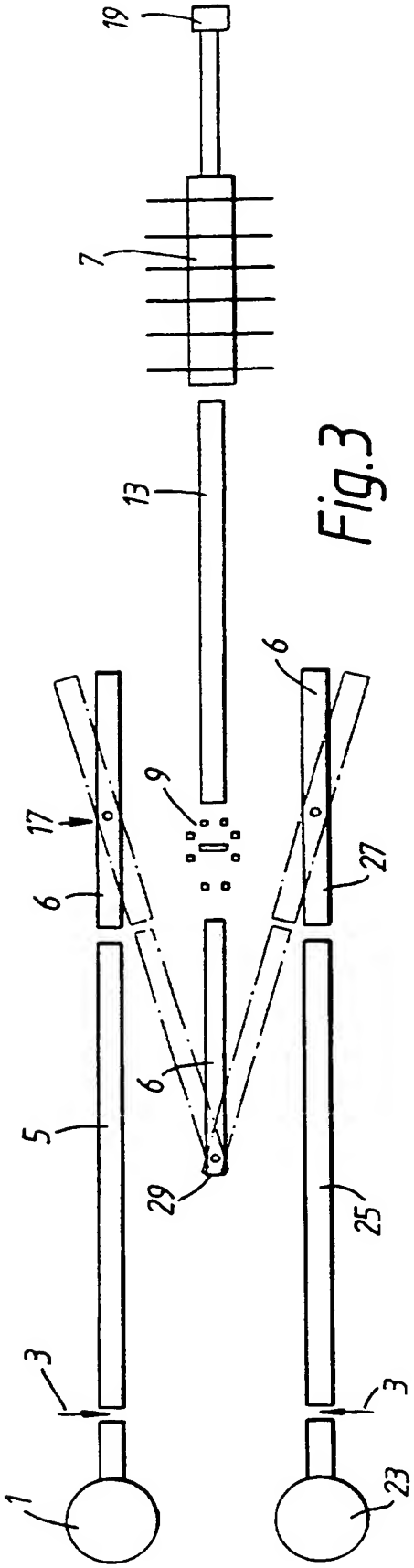

Fig.3

BNSDOCID: <GB_____2302054A__I_>

2302054

PRODUCTION OF METAL STRIP

This invention relates to the production of metal strip from molten metal. Continuous casters which are capable of casting metal bars are known. Usually the caster has a mould arranged with the longitudinal axis of its mould passage vertical and the cast bar exiting the mould is turned through 90^0 to move in a horizontal direction. The mould may have a curved mould passage which causes the cast bar to leave the mould in a direction inclined in the vertical and means are provided downstream of the mould to complete the change of direction of movement of the cast bar to the horizontal direction.

After casting, the bar is sheared into convenient lengths of a predetermined length which are subsequently rolled one at a time in a multistand hot strip mill to produce strip of the required gauge. Between the caster and the rolling mill, furnace means are provided for maintaining, or if necessary raising,the temperature of the cast bars to a value suitable for entry to the hot strip rolling mill.

When designing an installation for the production of rolled metal strip it is desirable for economic reasons to make the installation as compact as possible and for this reason it may not be convenient to align the path taken by a bar leaving the caster with the path taken by a bar entering the rolling mill.

According to the present invention an installation for the production of metal strip from molten metal comprises at

BNSDOCID: <GB_____2302054A__I_>

least one continuous caster capable of producing bar from molten metal;

a hot strip rolling mill for rolling portions of said bar of predetermined length to strip; and wherein the path taken by a bar exiting said continuous caster is not in alignment with the path taken by a bar entering the hot strip mill;

and a rotary turning table downstream of the said continuous caster, said table being movable between a first position which allows a portion of said bar of predetermined length from the caster to move onto the table and a second position in which a bar on the table can be moved to a position from which it can enter the rolling mill.

If the direction of casting and the direction of rolling are mutually at right angles, then the turntable has to be able to rotate through 90^{o} into aligned positions with the caster and the mill respectively.

A furnace enclosure may be mounted on the rotary table to reduce heat loss from the bar on the table. Furnace means comprising three parts may be provided, one aligned with the caster and which receives cast bars from the caster, one aligned with the entry end of the rolling mill and from which part the bars enter into the rolling mill and the third part is the rotary furnace between the other two parts and alignable with each of them.

The capacity of the hot strip rolling mill may be greater than the capacity of the continuous caster and so it may be advantageous to provide two continuous casters and the bars from the two casters are rolled one at a time in the hot strip rolling mill.

BNSDOCID: <GB_____2302054A__I_>

In the second position of the turning table, the table may be aligned with a second rotary turning table to allow a bar on the first table to be transferred to the second table and the second table is movable to a position in which it is aligned with the path taken by a bar entering the hot strip mill.

Each of the rotary furnaces is conveniently a furnace mounted on a turntable.

The first continuous caster may be permanently aligned with the rolling mill and initially if only one caster is provided, the furnace means does not have to include a rotary furnace because the passage of the bars from the caster is aligned with the passage of the bar through the rolling mill. When a second continuous caster is provided it is usual for it to be arranged side-by-side with the first caster but the passage of the bars from the second caster is not aligned with the passage of the bars through the rolling mill. By way of the present invention the output of the two casters can be supplied to the rolling mill.

When two continuous casters are employed it is usual to locate them side-by-side. The cast bars are cut into lengths of say 30 M and a device has to be provided for directing the bars one by one into alignment with the entrance to the rolling mill.

According to a further aspect of the present invention an installation for the production of metal strip comprises two continuous casters each capable of producing bar from molten metal; first and second turning tables each located

BNSDOCID: <GB 2302054A I >

downstream of a respective one of the continuous casters; a rolling mill and a third turning table upstream of the rolling mill; each of said three turning tables providing support for a cast bar, each of the first and second turning tables being alignable in turn with its continuous caster and with the third turning table, and said third turning table being alignable in turn with said first and second turning tables and with the rolling mill.

The distance from the continuous casters to the entrance to the rolling mill is clearly of great significance in the cost of setting up such an installation because the installation has to be located in a building and the cost of civil engineering and the erection of the building is dependent on the length of the building.

It is desirable to reduce the distance between the casters and the entrance to the rolling mill and thereby reduce the cost of the installation.

By locating the third turning table closer to the casters than are the first and second turning tables, the distance from the casters to the entrance to the mill can be reduced.

In order that the invention may be more readily understood it will now be described, by way of example only, with reference to the accompanying drawings in which:-

Fig. 1 is a diagrammatic plan view of an installation in accordance with one embodiment of the invention,

Fig. 2 is a diagrammatic plan view of an installation in accordance with a second embodiment of the invention and

Fig. 3 is a diagrammatic plan view of an installation

BNSDOCID: <GB_____2302054A__I_>

in accordance with a third embodiment of the invention.

Referring to figure 1 a continuous caster 1 receives molten metal and produces a bar, of say 80mm, thickness. The bar is cast vertically and is then turned through 90° by means not shown. The bar passes through a shear 3 and enters into a tunnel furnace 5. The bar is sheared into convenient lengths of, say, 25 metres. The length of the tunnel furnace is such that at least two bars can be retained therein in end-to-end relation. The direction of the path taken by the bars from the caster into the tunnel furnace 5 is at right angles to the direction of movement of a bar through a finishing hot strip rolling mill 7 of say six stands in tandem. Upstream of the rolling mill there are a conventional crop shear 9 and scale breaker 11. There is also an entry furnace 13 in alignment with the rolling mill. A single pass rougher 15 may optionally be provided at the entrance to the furnace 13.

To enable bars in the tunnel furnace 5 to be brought into alignment with the entry furnace 13, a rotary turning table 17 is interposed between the tunnel furnace 5 and the rougher 15 or between the tunnel furnace and the entry furnace 13 when the rougher is not provided. The rotary table comprises a furnace structure, of sufficient length to accommodate one bar, mounted on a turntable which rotates about a vertical axis.

In use, steel bars from the caster, sheared to length, pass into the tunnel furnace 5 where their temperature is maintained or increased if necessary to approximately 1100°c. The rotary furnace 17 is aligned with the tunnel

furnace 5 and a bar is transferred into the rotary furnace 17. The furnace is rotated through 90° and the bar is driven through the rougher and into the entry furnace 13. Heat loss on the table 17 is reduced by the enclosure. The temperature of the bar in the entry furnace is approximately 1150°c. When rolling is to commence, the bar is driven from the furnace through the crop shear and scalebreaker and into the finishing mill where is it rolled down to strip which is coiled on a coiler 19.

The rotary table enables the bars to be changed from the direction out of the tunnel furnace to the direction of the entry furnace and the rolling direction. In the arrangement shown this is 90° but other angles can easily be accommodated. Furthermore, a bar on the rotary table need not be transferred to the entry furnace 13. If a bar is found to be unsatisfactory for any reason it can be transferred to a reject or conditioning station 21 by rotating the rotary furnace to the position where it is aligned with the reject station and driving the bar from the rotary furnace to the station 21. At the reject or conditioning station a bar may be cooled and rectified or placed in a hot box for storage to maintain its temperature until it is ready to be returned to the mill line for rolling.

The furnace means of the embodiment of the invention is thus in three parts namely the tunnel furnace 5, the rotary furnace 17 and the entry furnace 13. It may be desirable to arrange for the tunnel furnace 5 or the entry furnace 13 to be such that a number of bars can be stored in the furnace

BNSDOCID: <GB_____2302054A__I_>

in the event that the bars are being cast at a rate which is faster than they are being rolled. This could occur if for example one or more stands of the finishing mill are having their rolls changed and so rolling has stopped.

Referring to figure 2, a first continuous caster 23 receives molten metal and produces a bar of say 80mm thickness. The bar is cast vertically and is then turned through 90^{o} by means not shown. The bar passes through a shear (not shown) where it is sheared into lengths which enter into a tunnel furnace 25. The length of the tunnel furnace is such that one and maybe two or more bars can be retained therein in end-to-end relation. Downstream of the furnace 25 there is a roughing mill 15 and an entry furnace 13. A multi-stand hot strip rolling mill 7 is positioned downstream of the furnace 13. The passage of the cast bar through the furnaces 25 and 13 is in alignment with the passage of the bar through the rolling mill as it is rolled to strip. The strip is eventually coiled by a coiler 19.

If a second continuous caster 1 is provided, the physical layout of the plant may make it necessary to locate the second caster 1 with its tunnel furnace 5 side-by-side with the caster 23 and the furnace 25. The passage of a bar from the caster 1 through the furnace 5 will not be in alignment with the passage through the mill 7. To this end two rotary turning tables each having a furnace enclosure are provided. A first table 27 is positioned between the furnaces 25 and 13 and can be aligned with them. This means that bars from the furnace 25 pass straight across the table 27 into the entry furnace 13. A second rotary table

BNSDOCID <GB ____2302054A__I_>

17 is located downstream of the tunnel furnace 5. This table can be aligned with the furnace 5 and the two tables 17 and 27 can be aligned with each other. Hence, bars from the tunnel furnace 5 can be passed into the rotary furnace 17, this furnace can then be aligned with the rotary furnace 27 and the bars passed from table 17 onto table 27. Rotary furnace 27 is then rotated into alignment with the entry furnace 13 and the bar is passed through the roughing mill and into the finishing mill.

It may be desirable for the tunnel furnaces 5, 25 and the entry furnace 13 to be such that a number of bars can be stored in the furnace in the event that the bars are being cast at a rate which is faster than they are being rolled. This could occur if for example one or more stands of the finishing mill are having their rolls changed and so rolling is stopped.

The furnaces can have provision for adding heat to a bar therein or they can simply reduce the heat loss from a bar therein.

Referring now to figure 3, two continuous casters 1, 23 are supplied with molten metal and produce continuous lengths of bar. The casters are arranged side-by-side and the cast bars from the two casters move along substantially parallel paths. A shear 3 is positioned downstream of each caster and downstream of each shear there is an elongate tunnel furnace 5,25 respectively. The cast bar from each caster is sheared into lengths of say 30 metres. The length of each tunnel furnace 5, 25 may be such as to accommodate one bar but is conveniently such that it can accommodate two

BNSDOCID: <GB_____2302054A__I_>

or more bars in end-to-end relation.

Downstream of each tunnel furnace there is a respective first and second turning table 17,27. Conveniently an elongate insulated housing 6 which is capable of receiving one length of bar is mounted on each table. At a position between the tunnel furnaces 17,27 and closer to the casters than the turning tables, there is a third turning table 29 which again has an elongate housing 6 which is capable of receiving one length of bar. The third turning table 29 is positioned upstream of a rolling mill which comprises a multi stand hot strip finishing mill 7 and which may be preceded by one or more roughers 9. Between the rougher(s), when provided, and the finishing mill 7 there is a further tunnel furnace 13 and downstream of the finishing mill there is a down coiler 19.

The tunnel furnaces 5,25 and 13 and the insulated housings 6 which may be provided on the turning tables are arranged to ensure that the bars are at the correct rolling temperature when they enter the hot finishing mill 7. To this end the furnaces and the insulated housings can add heat to a bar therein or they can simply reduce the heat loss from a bar therein.

In use, cast bar is produced by each caster and the bars enter into the tunnel furnaces 5,25. After a convenient length has been cast from each caster, the bar is severed by the shear 3 and it moves to the far end of the tunnel furnace away from the caster. A new cast bar continues to enter into the tunnel furnace which can store two or more bars in end-to-end relation. The housing 6 on

each of the turning tables 17,27 is aligned with the corresponding tunnel furnace 5,25 and a bar moves from the furnace into the housing. Each turning table is moved, in turn, through a relatively small angle until its housing 6 is in alignment with the housing 6 on the third turning table 29 which has also been turned through a small angle. The bar in the housing on a turning table 17 is then reversed back through the same end of the housing that it entered the housing into the housing 6 of the third turning table 29. Thus when moving from the first or second turning table to the third turning table a bar is moving in a direction away from the finishing mill 7.

When a bar has been received in the housing on the third turning table, the table is then moved to a position where it is aligned with the entrance to the rolling mill. The bar is then driven through the rougher(s) 9 and into the tunnel furnace 13. As soon as the finishing mill is ready to roll a bar, the bar is in the tunnel furnace 13 is driven into the mill where it is rolled to metal strip and subsequently coiled.

By arranging for a bar in one of the respective turning tables 17,27 to be reversed back towards the caster into the housing on the third turning table, the turning tables 17,27 can be positioned on opposite sides of the entrance to the rolling mill and the third turning table is located between the tunnel furnaces 5 and 25, and this reduces the overall length of the installation.

In an alternative arrangement, one or more roughers 9 may be positioned on the opposite side of the third turning

BNSDOCID: <GB_____2302054A__I_>

table 29 from the finishing mill. After the bar has moved onto the third turning able, the table is aligned with the entrance to the finishing mill but the bar is moved away from the finishing mill and receives one or more passes through the roughing stand. The bar then passes over the third turning table and into the tunnel furnace 13. This enables the finishing mill 7 to be brought closer to the third turning table 29 thus reducing further the overall length of the installation.

BNSDOCID: <GB . ____2302054A__I_>

Claims:

1. An installation for the production of metal strip from molten metal comprises at least one continuous caster capable of producing bar from molten metal;

a hot strip rolling mill for rolling portions of said bar of predetermined length to strip; and wherein the path taken by a bar exiting said continuous caster is not in alignment with the path taken by a bar entering the hot strip mill;

and a rotary turning table downstream of the said continuous caster, said table being movable between a first position which allows a portion of said bar of predetermined length from the caster to move onto the table and a second position in which a bar on the table can be moved to a position from which it can enter the rolling mill.

2. An installation as claimed in claim 1 in which the path taken by a bar exiting said caster is substantially at right angles to the path of a bar entering the hot strip mill and said rotary table can be moved between the first and second positions in which it is aligned with said respective paths.

3. An installation as claimed in claim 1 in which in the second position of the turning table, the table is aligned with a second rotary turning table to allow a bar on the first table to be transferred to the second table, and the second table is movable to a position in which it is aligned with the path taken by a bar entering the hot strip mill.

BNSDOCID: <GB_____2302054A__I_>

4. An installation as claimed in claim 3 in which the second table is also alignable with the path taken by a bar exiting from a second continuous caster.

5. An installation as claimed in claim 4 in which the two continuous casters are arranged in side-by-side parallel relation and with the path taken by bar exiting the second caster being aligned with the path taken by a bar entering the hot strip mill.

6. An installation as claimed in claim 1 in which there are two continuous casters each capable of producing bar from molten metal; there are first and second rotary turning tables each located downstream of a respective one of the casters; a third rotary turning table is provided upstream of the rolling mill and each of the turning tables provides a support for a cast bar, each of the first and second turning tables is alignable in turn with the path taken by a bar exiting its continuous caster and with the third turning table and the third turning table is alignable in turn with the first and second turning tables and with the path taken by a bar entering rolling mill.

7. An installation as claimed in claim 6 in which the third turning table is located closer to the casters than are the first and second casters.

8. An installation as claimed in any preceding claim in which the or each rotary turning table is provided with an

enclosure for receiving the bar on the table, the enclosure serving to at least reduce heat loss from the bar.

9. An installation as claimed in any preceding claim in which the or each rotary turning table can be moved to a further position which allows a bar on the table to be displaced to a reject station.

10. An installation substantially as hereinbefore described with reference to the accompanying drawings.

BNSDOCID: <GB_____2302054A__I_>

The Patent Office

15

Application No: GB 9611446.7
Claims searched: 1-10

Examiner: Peter Beddoe
Date of search: 19 July 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B3F (FAA,FCF,FNK); B3M (MC); B3A

Int Cl (Ed.6): B21B (1/46,13/22)

Other: Online: WPI, CLAIMS

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1298323	(MANNESMANN) see esp page 2 lines 64-88 & fig 1	1
X	US 5146781	(McKEE) see esp col 3 lines 12-35 & fig 3	1
X	Patent Abstracts of Japan vol 6 no 216 (M-168), 1982 & JP 570121809 A (SHIN) see abstract		1
A	GB 1408827	(HENKE) see esp page 3 lines 1-35 & fig 1	1
A	GB 1183646	(BOHLER) see whole doc	1
A	GB 1117952	(US STEEL) see esp page 2 line 8 - page 3 line 104 & fig 1	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

BNSDOCID <GB_____2302054A__I_>